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Fizik konularının yaşamla ilişkilendirilme düzeyi: Ortaöğretim fizik dersi öğretim programının analizi

The level of associating physics subjects with life: Analysis of the secondary school physics curriculum

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ÖZ

Bu araştırmada ortaöğretim fizik dersi öğretim programının yaşamla ilişkilendirilme düzeyinin belirlenmesi ve dolayısıyla öğrencilerin bu ders kapsamında yaşama ne düzeyde hazırlanabileceğinin saptanması amaçlanmıştır. Araştırmada nitel araştırma yöntemlerinden doküman analizi yönteminden yararlanılmıştır. Araştırmanın veri kaynağını Talim ve Terbiye Kurulu tarafından 2018 yılında yayımlanan ortaöğretim fizik dersi (9, 10, 11 ve 12. sınıflar) öğretim programı oluşturmaktadır. Ortaöğretim Fizik Dersi Öğretim Programı, "Fen Bilimleri Dersinin Yaşamla İlişkilendirilmesine İlişkin Tema ve Göstergeler" kullanılarak içerik analizi yöntemi ile bütüncül ve ayrıntılı şekilde çözümlenmiştir. Araştırmada Ortaöğretim fizik dersi öğretim programı iki bölüm altında incelenmiştir. İlk bölümde "Millî Eğitim Bakanlığı Öğretim Programları" ve "Ortaöğretim Fizik Dersi Öğretim Programının Uygulanması", ikinci bölümde ise "Ortaöğretim Fizik Dersi Öğretim Programının Yapısı" içerisinde yer alan ünite, konu, kazanım ve açıklamaların altındaki kazanımlar ve açıklamalar incelenmiştir. Araştırma sonucunda ortaöğretim fizik dersi öğretim programı içerisinde "Yaşamla İlişkilendirmeye" sıklıkla vurgu yapıldığı belirlenmiştir. Ortaöğretim fizik dersi öğretim programında yaşamla ilişkilendirmeye yapılan vurgu ile fen okuryazar bireylerin yetiştirilmesinin desteklendiği ifade edilebilir. Öğrencilerin fizik bilgilerini günlük yaşam problemlerinde kullanmalarının istenmesi ile eleştirel düşünme becerilerinin gelişiminin desteklendiği ortaya çıkmıştır. Aynı zamanda öğrencilerin fiziğin yaşamın bir parçası olduğunu keşfederek olası öğrenme güçlüklerinin önüne geçilmesinin amaçlandığı ifade edilebilir.

*Anahtar Sözcükler***:** fizik eğitimi, öğretim programları, fen okuryazarlığı, yaşamda bilim, günlük yaşam

ABSTRACT

This research aims to ascertain the extent of association between the secondary school physics course curriculum and real-life situations. The goal is to determine how well students can be prepared for life within the scope of this course. The research employed the document analysis method, one of the qualitative research methods. The data source for this research is the secondary school physics course curriculum (grades 9th through 12th), published by the Board of Education in 2018. The Secondary School Physics Curriculum was analyzed comprehensively and in detail using the content analysis method, specifically focusing on the 'Themes and Indicators Related to Relating the Science Course to Life.' The research examined the secondary school physics curriculum in two sections. In the first part, the 'Ministry of National Education Curriculum' and the 'Implementation of the Secondary Education Physics Course Curriculum' were scrutinized. In the second part, the achievements and explanations related to the units, subjects, and 'Relation to Life' under the 'Structure of the Secondary School Physics Course Curriculum' were examined. The research revealed a frequent emphasis on 'Relation to Life' in the secondary school physics curriculum. It can be asserted that the education of scientifically literate individuals is reinforced by emphasizing its connection to everyday life in the secondary school physics curriculum. The study has uncovered that the cultivation of critical thinking skills is promoted through tasks that require students to apply their physics knowledge to real-life problems. It can be stated that the physics program also aims to prevent possible learning difficulties in students by enabling them to discover that physics is a part of life.

*Keywords***:** physics education, curriculum, science literacy, science in life, daily life

INTRODUCTION

Physics is an integral part of human life, forming the basis of nature and existence. For instance, the operating principles of many devices we use in our homes, such as kettles, tea makers, irons, hair dryers, etc., are based on physics. Natural events, like the formation of rainbows, the occurrence of tornadoes, and the appearance of the northern lights, are explained by physics. Everyday occurrences, such as water evaporating while cooking, salt dissolving in water, food cooking faster in specific pots, the tip of a heated metal spoon burning our hands, hearing sound from the television, the mirror reflecting incoming light, and the use of automatic doors, underscore the importance of physics in our lives (Kristiyanto, 2022). In conclusion, it is believed that the field of physics, which lies at the core of our lives, provides individuals with the opportunity to comprehend, explain, and control various situations, as mentioned above (Ültay & Yeşilyurt, 2018). However, despite the acknowledgment that physics underlies daily life and natural events, research indicates that contemporary students still perceive physics subjects as boring, complex, difficult, and disconnected from daily life (Veronika et al., 2017; Wong et al., 2023). This perception raises concerns regarding the meaningful teaching and learning of physics in the educational environment (Uden et al., 2023). Establishing a bridge between life and learning in physics lessons is recognized as effective in alleviating this concern, as meaningful learning occurs when students can apply physics concepts to their lives. Otherwise, individuals may possess information that leads to unscientific generalizations (Poquet et al., 2021). Therefore, it is vital for students to relate the concepts, facts, and events in the physics course to their daily lives. It is understood that these conditions will manifest in physics education through a well-designed and effective curriculum (Akgün et al., 2015; Bosser, 2017).

The curriculum serves as an educational framework for teachers and a learning experience for students (Ertürk, 2013). In essence, curricula constitute fundamental components in achieving national goals. Aligned with the learning objectives each student is expected to attain, they serve as a reference source. It is recognized that curricula must meet certain critical criteria. For instance, as curricula guide teachers and significantly influence teaching, there is a need to explore how official curricula serve as resources for connecting lessons to real-life situations and what policy framework they provide for this purpose. In the prevailing conception of curricula, the goal of preparing individuals for the real world takes precedence. Particularly in the field of science, the aspiration is to nurture individuals capable of generating knowledge and applying it to technology (Rafanan, De Guzman & Rogayan, 2020). In Turkey, the Secondary School Physics Curriculum, devised by the Ministry of National Education (MoNE), aims to cultivate individuals who can produce knowledge and apply it functionally in life (MoNE, 2018). The curriculum emphasizes that this goal should be complemented by digital competence. Thus, with technological support, it is anticipated that the development of scientifically literate individuals in our country will flourish. This, it is believed, will facilitate a more seamless understanding of scientific knowledge and contribute to simplifying daily life within the triad of humans, nature, and technology (Purba et al., 2019). This interconnectedness is crucial as it is known that it is through this lens that scientifically literate individuals develop the ability to analyze events, observe, and comprehend explanations about various situations (Collins, 1997; Roberts & Bybee, 2014). In conclusion, the objectives of the secondary school physics curriculum in Turkey, as outlined in the international literature, aim to produce individuals who comprehend science and can apply it in their daily lives. The ultimate goal is to cultivate scientifically literate individuals capable of addressing daily life challenges with ease (MoNE, 2018). In this context, when the studies carried out in line with these qualifications expressed in the secondary school physics curriculum in Turkey were examined, it was found that various methods and techniques that can be used during teaching were suggested in associating the subjects with life. For example, Taşkın and Moğol (2016) found that creative drama technique, and Baran, Maskan, and Yaşar (2018) found that project-based learning games were effective in students' associating physics knowledge with daily life. These studies suggest that various methods and techniques can strengthen the connection between physics and daily life. However, many studies in the field of science education in Turkey have also pointed out that students struggle to relate their

knowledge to everyday life (Canpolat & Ayyıldız, 2019; Cengiz & Ayvacı, 2017). In addition, a study by Tanuğur, Ogan-Bekiroğlu, Gürel, and Süzük (2012) examined the level of integration of the Secondary School Physics Curriculum with daily life from the perspective of teachers. The research found that teachers believed the curriculum partially integrated physics with daily life. Dülger and Ogan-Bekiroğlu (2023) examined activities in high school physics textbooks. The study found that prospective teachers did not consider high school physics textbooks fully effective in relating knowledge to daily life. Consequently, based on the premise that students struggle to fully understand the relationship between the concepts they learn and daily life, there is a need for a detailed analysis of the level of integration of the Secondary School Physics Curriculum with daily life. This research aims to determine the level of integration of the Secondary School Physics Curriculum with daily life and, consequently, assess how well students can be prepared for life within the scope of this course.

METHOD

In this research, the document analysis method, a qualitative research approach, was employed to assess the extent to which the Secondary School Physics Curriculum in Turkey is integrated with daily life. The systematic examination of materials containing information relevant to the research problem was conducted through document analysis (Cansız-Aktaş, 2019). The stages of document analysis, followed sequentially, involved accessing the document, verifying its authenticity, comprehending its content, analyzing the data, and utilizing the findings (Forster, 1975; cited in Yıldırım & Şimşek, 2016). This approach was deemed suitable for the research, as it enables a thorough exploration of the roots of the research problem.

Data Source

The data source for this study is the secondary school physics curriculum for grades 9th through 12th, published in 2018 in Turkey. This curriculum has been in effect since its publication date and has received approval from the Board of Education (MoNE, 2018).

Data Analysis

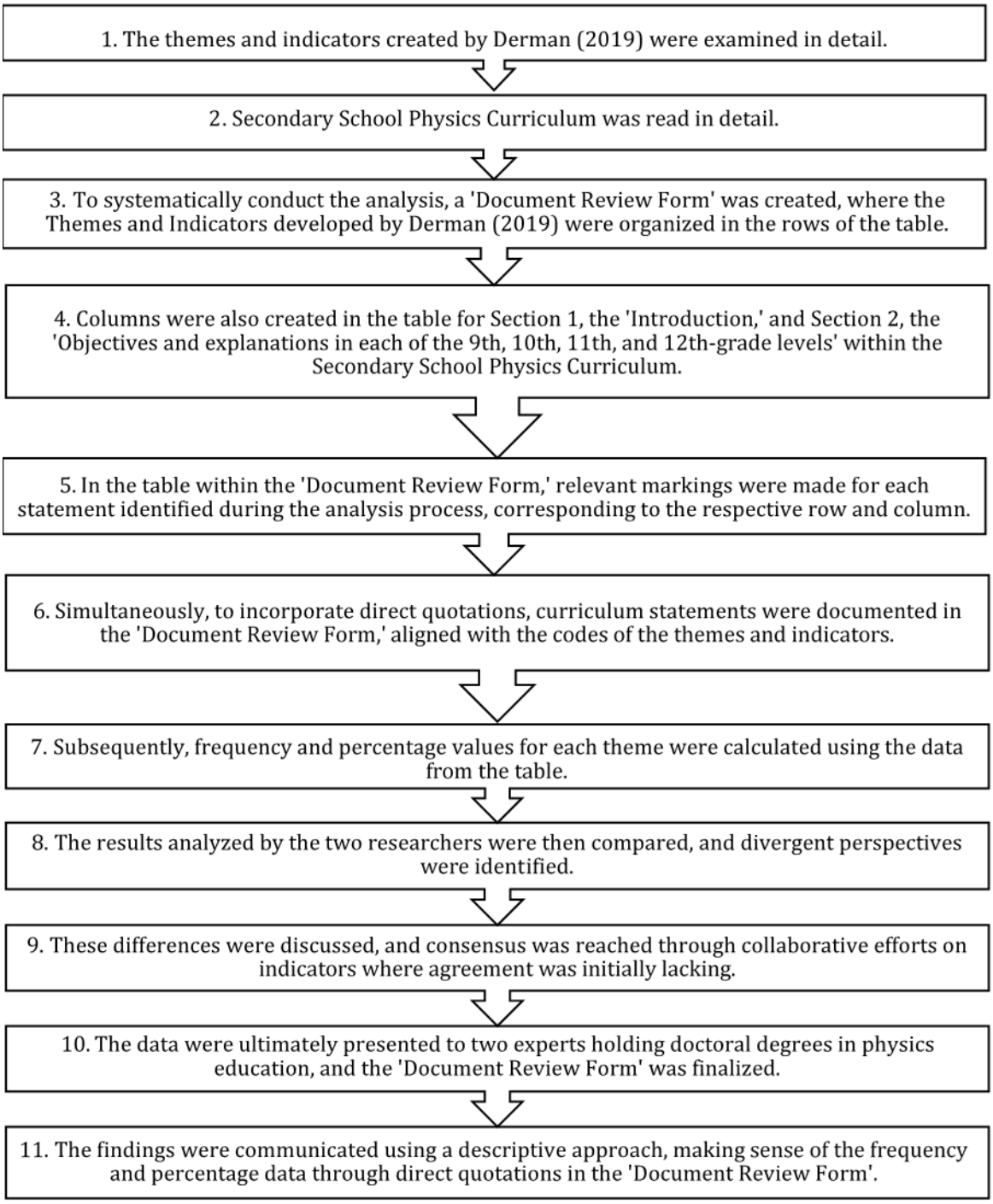
The '2018 Secondary School Physics Curriculum,' accessible electronically on the official Board of Education website, underwent a comprehensive content analysis using the document analysis method. The focus of the analysis was on the 'Themes and Indicators regarding Associating Science Course with Life,' outlined by Derman (2019). These criteria comprised a total of 33 indicators, organized into six themes: effective learning environment (7 indicators), basic concepts and knowledge (5 indicators), the role of science (5 indicators), science communication (6 indicators), scientific research (3 indicators), and assessment and evaluation (7 indicators). The selection of these themes and indicators was guided by 62 hours of observations in three schools in the central districts of Ankara, considering their socio-economic and socio-cultural backgrounds (Derman, 2019). Additionally, the analysis examined the curricula of ten countries recognized for success in international examinations and knowledge transfer to technology. These countries included global leaders such as the United States and the United Kingdom, as well as top performers in PISA 2015 (Singapore, Japan, Estonia, Taiwan-China, and Finland) and TIMSS 2015 (Singapore, South Korea, Japan, Russia, and Hong Kong) (MoNE, 2016a; MoNE, 2016b). Derman (2019) sought expert opinions to validate the scope of the table detailing countries and indicators.

Upon examination of the curricula published by the Ministry of National Education, it becomes evident that, following the introductory section of the curriculum (which includes the vision, objectives, and fundamental approaches), objectives and explanations are outlined under specific subject areas and units. In this study, with consideration given to the themes and indicators prepared by Derman (2019), the Secondary School Physics Curriculum was examined in two sections. The first section entails an analysis of the sections titled "Ministry of National Education Curricula" and "Implementation of the Secondary School Physics Curriculum,"

elucidating the overall structure of the curriculum. The second section involves an examination of the objectives and explanations corresponding to each grade level under the units, subjects, objectives, and explanations outlined in the 'Structure of the Secondary School Physics Curriculum.' Both sections were comprehensively assessed with the goal of providing insights into the 'Themes and Indicators regarding Associating Science Course with Life.

The researchers followed the procedure outlined in Figure 1 throughout the analysis process.

Figure 1
Analysis Steps of the Research



Validity and Reliability Studies

To ensure the reliability of the analysis results, two experts with doctoral degrees in physics education conducted independent content analysis of the secondary school physics curriculum. Both experts conducted a thorough examination of the introductory section, objectives, and explanations at this stage, giving extensive consideration to each of the 33 indicators. In this context, for example, it was discovered that one expert coded their objective "9.5.5.1. Interpret the effects of expansion and contraction in solids and liquids in daily life." solely using the C2.a indicator, while the other expert associated this attainment with both the E1.h indicator as well. Upon comparison, it was observed that an explanation or outcome could fall under more than one theme, as illustrated in the example. The percentage of agreement between experts was calculated as 76% following the initial analysis, according to Miles & Huberman (1994). Subsequently, the experts convened to compare the gathered data and reconcile any disparities. They deliberated on the differences in their codings, and this process persisted until a complete consensus of 100% was reached between them. (Yıldırım & Şimşek, 2016).

Research Ethics

All the rules outlined in the 'Higher Education Institutions Scientific Research and Publication Ethics Directive' were adhered to throughout the entire process, from planning and implementation to data collection and analysis. No actions specified under the second section of the directive, 'Scientific Research and Publication Ethics Actions,' were undertaken.

Throughout the writing process of this study, scientific, ethical, and citation rules were rigorously followed. There was no falsification of the collected data, and the study was not submitted to any other academic outlets for evaluation.

Research ethics committee approval information

As this study falls under the category of document analysis research, which does not require Ethics Committee Approval, it is not considered among studies that necessitate such approval. Therefore, no Ethics Committee Approval has been obtained for this study.

FINDINGS

This study aims to address the question, 'To what extent is the Secondary School Physics Curriculum associated with life?'. The findings from the examination of the 2018 Secondary School Physics Curriculum for this purpose are categorized under two main headings. The first section presents results related to the 'Ministry of National Education Curricula' and 'Implementation of the Secondary School Physics Curriculum' titles, collectively referred to as the 'Introduction' section of the curriculum. The second section encompasses findings related to the 'Structure of the Secondary School Physics Curriculum' title, detailing the objectives and explanations for the 9th, 10th, 11th, and 12th-grade curricula. The distribution of findings for both sections under the themes is presented in Table 1.

Table 1
Document Analysis Results of Secondary School Physics Curriculum

	Secondary School Physics Curriculum									
			Section 2: Objectives and Explanations							
	Section 1: Introduction		Grade 9	Grade 10	Grade 11	Grade 12	Section 2 Total		Overall Total	
Themes	f	%	f	f	f	f	f	%	f	%
A. Effective Learning Environment	11	10.3	26	39	24	25	114	15.0	125	14.4
B. Basic Concepts and Principles	6	5.6	68	63	65	64	260	34.3	266	30.7
C. The Role of Science	49	45.8	47	35	44	44	170	22.4	219	25.3
D. Science Communication	17	15.9	25	18	26	19	88	11.6	105	12.1
E. Scientific Research	15	14.0	25	32	39	31	127	16.7	142	16.4
F. Measurement and Evaluation	9	8.4	-	-	-	-	-	0	9	1
Total	107	100	191	187	198	183	759	100	866	100

Note: The total number of objectives is 213.

According to Table 1, the secondary school physics curriculum emphasized 'Relating to Life' a total of 866 times. In this context, the highest emphasis was on 'Basic Concepts and Principles' (f=266, 30.7%), while 'Measurement and Evaluation' received a minor focus (f=9, 1%). When evaluating the 'Introduction' and 'Objectives and Explanations' separately, in the 'Introduction' part (Section 1), the majority of statements related to the 'The Role of Science' theme (f=49, 45.8%) were found. In the 'Objectives and Explanations' part (Section 2), most associations were made with the 'Basic Concepts and Principles' theme (f=260, 34.3%). The 'Introduction' part (Section 1) included the fewest statements related to the theme of 'Basic Concepts and Principles' (f=6, 5.6%). It was concluded that there was no association with the theme of 'Measurement and Evaluation' in the 'Objectives and Explanations' section (Section 2).

Below are sample statements associated with each theme related to 'Associating with Life' in the 'Introduction' section of the Secondary School Physics Curriculum, discussed in the first part of the research:

Sample statements related to the "Effective Learning Environment" theme;

> A2: *"Digital competence: Covers the safe and critical use of **information and communication technologies** for work, daily life and communication."*
>
> A6: *"In case of inadequacy of the physical environment in objectives involving experiments and simulations, the teacher should conduct **demonstration experiments**..."*

Sample statements related to the theme of "Basic Concepts and Principles";

> B1: *"Teachers should ensure that students have the **knowledge and skills needed** for scientific activities in the classroom and laboratory."*
>
> B2: *"Learning to learn mobilizes learners to build on **prior learning and life experiences** to use and apply knowledge and skills in various contexts, such as the home, workplace, education and training environment."*

Sample statements related to the theme "The Role of Science";

> C2: *"**Associating the subjects with daily life** and choosing problems based on events that students can encounter will ensure permanent learning."*
>
> C3: *" The aim is to interpret the ideas and works of prominent thinkers and scientists who have shaped the history of our civilization."*

Sample statements related to the theme of "Science Communication";

> D2: " Making scientifically informed decisions regarding physics applications, taking into account ethical and social implications."
>
> D4: *"...**sharing scientific knowledge.**"*

Sample statements related to the theme of "Scientific Research";

> E1: *"**Obtaining data** by conducting experiments, **inferring, interpreting and making generalizations** using these data..."*
>
> E2: "*To produce scientific knowledge and solve problems **using scientific process skills...**"*

Sample statements related to the theme of "Measurement and Evaluation";

> F1: "*Measurement and evaluation practices in education are an integral part of education and are carried out **throughout the educational process**."*
>
> F6: *"...it is essential to act with **maximum diversity and flexibility** in the measurement and evaluation process."*

In the second section of the curriculum, the 'Objectives and Explanations' for the 9th-12th grade subject areas and units were meticulously analyzed within the framework of the themes and indicators established for 'Relating Science Lesson to Life.' The detailed analyses of 213 objectives and explanations in the Secondary School Physics Curriculum are presented below.

The 'Effective Learning Environment' theme comprises seven indicators, and the findings related to these indicators are presented in Table 2.

Table 2
"Effective Learning Environment" Theme Analysis Results and Statement Examples

A. EFFECTIVE LEARNING ENVIRONMENT	f	%	Example of a statement
1. Organize the physical characteristics of the environment to increase student-teacher and student-student interaction	-	-	
2. Utilization of information and communication technologies (ICT)	52	*6.9*	*12.5.3.2.c) Students observe and interpret the variables affecting the photoelectric phenomenon with the **help of simulations**.*
3. Using laboratory (laboratory equipment)	51	*6.7*	*11.1.8.2.a) Students can conclude the variables on which torque depends **by conducting experiments**.*
4. Utilizing out-of-school learning environments	-	-	
5. Utilizing daily life materials (Household tools, etc.)	-	-	
6. Utilizing scientific resources appropriate to the level of students	-	-	
7. Utilizing visuals a. Models (f=9) b. Posters (f=1) c. Video (f=1)	11	*1.4*	*11.2.4.10. a) The **mathematical model** of the Lorentz force is given.* *12.6.5.1.a) ... with the **help of videos**, the formation of the LASER beam is examined.*
TOTAL	114	*15*	

According to Table 2, in the 'Objectives and Explanations' section under the 'Effective Learning Environment' theme, the indicators 'Utilizing information and communication technologies (ICT)' (f=52, 6.9%) and 'Using laboratory equipment' (f=51, 6.7%) received the most emphasis. There was less emphasis on the indicator 'Utilizing visuals' (f=11, 1.4%). For instance, the outcome statement emphasizing students' utilization of simulations supports the integration of information and communication technologies within the teaching process, aligning with the A2

indicator. Additionally, presenting mathematical models as a component of teaching encourages the use of visuals in education, correlating with indicator A7.

Furthermore, Table 2 illustrates the absence of a correlation between A1, A4, A5, and A6 indicators and objectives. Concerning A1, A4, and A6 indicators, no statements were identified within the objectives that involved altering the physical conditions of the classroom, guiding students to utilize learning environments outside of school, or supporting students' familiarity with scientific sources. Additionally, the A5 indicator pertains to the introduction of daily life tools and equipment into the classroom to facilitate student engagement with these materials in the classroom environment. For instance, certain program objectives ("11.1.10.2. b) Calculations are made on simple machine examples (such as a key) used in daily life," "10.2.1.2. d) By emphasizing that blood pressure is the blood pressure in the veins, students are encouraged to investigate the working principle of the blood pressure monitor," etc.) make reference to daily life materials. However, despite mentioning these materials, they do not explicitly highlight their use within the classroom setting. Consequently, it was deemed appropriate to associate these types of accomplishments with the C2.a indicator instead of the A5 indicator in this research (Refer to Table 4).

Under the 'Basic Concepts and Principles' theme, the association of the science course with life was addressed through five indicators. The analysis results are presented in Table 3.

Table 3
"Basic Concepts and Principles" Theme Analysis Results and Statement Examples

B. BASIC CONCEPTS AND PRINCIPLES	f	%	*Example of a statement*
1. Sharing scientific facts, facts, concepts and principles related to the subject with students in a correct/accurate manner	114	15	*9.2.2.1.* ***Explains the concept*** *of endurance.* *11.1.8.1.* ***Explains the concept*** *of torque.*
2. Preparing students for learning	13	1.7	*12.2.1.1. Explain simple harmonic motion* ***using uniform circular motion****.*
3. Concretizing concepts and principles	30	4	*9.6.1.1. Explain the types of electrical charge* ***with examples****.*
4. Ensuring that learning strategies are utilized	11	1.4	*10.1.4.1.b)* ***The right-hand rule*** *is given.*
5. Ensuring the use of learned concepts and principles in new situations a. Solving questions (f=42) b. Doing Activities/Experiments (f=50)	92	12.1	*10.3.2.1.* ***Explains the difference between*** *pulse and periodic wave.* *11.1.7.4.* ***Makes calculations*** *related to the conservation of linear momentum.*
TOTAL	260	34.3	

As shown in Table 3, under the 'Basic Concepts and Principles' theme, the indicator 'Sharing scientific facts, concepts, and principles related to the subject with students in a correct/accurate way' (f=114, 15%) received the highest emphasis. Following this, the indicators 'Ensuring the use of learned concepts and principles in new situations' (f=92, 12.1%), 'Concretizing concepts and principles' (f=30, 4%), 'Preparing students for learning' (f=13, 1.7%), and 'Ensuring that learning strategies are utilized' (f=11, 1.4%) were emphasized in descending order.

Upon close examination of the provided examples: The students' proficiency in explaining the concept of torque aligns with the B1 indicator. This association is justified by the importance of accurately conveying scientific concepts related to the topic to students, ensuring precision and minimizing errors. Additionally, the capability to perform calculations concerning the conservation of linear momentum, as mentioned in another objective statement, appears to correspond with addressing problems related to the B5.a indicator.

Five indicators were identified under the 'The Role of Science' theme, and the analysis results are presented in Table 4.

Table 4
"The Role of Science" Theme Analysis Results and Statement Examples

C. THE ROLE OF SCIENCE	f	%	*Example of a statement*
1. Utilizing the knowledge of various disciplines a. Mathematics (f=51) b. Geometry (f=3) c. Art (f=2) d. Other (f=5)	61	*8*	*9.1.2.1. Relates the application areas of physics with its **sub-branches and other disciplines**.* *11.1.1.3. Calculates **the components of vectors** using different methods.* *b) Finding the magnitude of the composite vector **by giving the cosine theorem**.* *11.2.4.10. a) The **mathematical model** of the Lorentz force is given.*
2. Connecting with life a. Simple daily life situations (f=39) b. Technology/Industry/Engineering (f=22) c. Environment/Nature/Sustainability (f=9) d. Health/Human body (f=4) e. Cultural/Economic/Social values (f=4)	78	*10.3*	*9.5.5.1. Interpret the effects of expansion and contraction in solids and liquids in **daily life**.* *10.4.7.1.b) Explain that glass bottles and broken glass act like lenses and cause forest fires. The importance of **environmental cleanliness and protecting natural life** is emphasized.*
3. Giving place to the historical development of scientific ideas	12	*1.6*	*12.4.1.1. a) Theories other than Bohr's atomic theory are given **in the historical development process** without going into detail.*
4. Giving place to the working methods of scientists	16	*2.1*	*9.1.4.1. Explains **the importance of science research centres** for physical science.*
5. Recognizing the professions and business areas related to science	3	*0.4*	*9.2.1.1.1.1 - The fields of work in which mass is used, such as **jewellery making, porcelain making, and marbling are mentioned**.*
TOTAL	170	*22.4*	

Examining Table 4, it was determined that under the 'The Role of Science' theme, the indicator 'Connections with life' (f=78, 10.3%) received the most emphasis. Within this indicator, 'Simple daily life situations' (f=39, 5.2%) were the most frequently observed. Following this, associations were found in the indicator 'Utilizing the knowledge of various disciplines' (f=61, 8%), with most associations linked to the discipline of mathematics. Less emphasis was placed on the indicators 'Giving place to the historical development of scientific ideas' (f=12, 1.6%), 'Giving place to the working methods of scientists' (f=16, 2.1%), and 'Recognizing the professions and business areas related to science' (f=3, 0.4%).

When examining the provided examples in detail, students' capacity to interpret the effects of expansion and contraction events in solids and liquids in daily life correlates with establishing a connection to real-life scenarios, as outlined in the C2 indicator. Furthermore, the application of geometry knowledge in calculating combinations of vectors using various methods, as depicted in another objective statement, indicates the utilization of knowledge from different disciplines, aligning with the C1 indicator.

There are six indicators under the 'Science Communication' theme, and findings related to these indicators are presented in Table 5.

Table 5
"Science Communication" Theme Analysis Results and Statement Examples

D. SCIENCE COMMUNICATION	f	%	*Example of a statement*
1. Ensure correct technical/scientific terminology (SI, IUPAC system, etc.)	9	*1.2*	*9.2.1.1. a) The concepts of mass and volume are mentioned. Meaningful unit conversions are made for mass* ***(mg, g, kg and tons)*** *and volume* ***(mL, L, cm^3, dm^3, m^3).***
2. Guiding students to access reliable sources of information by enabling them to distinguish between scientific knowledge and myths	-	-	
3. To be able to express knowledge in different ways a. Writing a scientific text/report (f=1) b. Creating/reading graphics (f=16) c. Writing/understanding numerical expressions (f=33) d. Modelling/understanding (f=18)	68	*9*	*9.3.1.3. b) Students are enabled to derive and* ***interpret mathematical models*** *related to motion by using graphs.* *10.3.3.4. a) Students can* ***draw the refraction movements of water waves*** *by conducting experiments or simulations.*
4. Enabling students to make presentations using scientific language	5	*0.7*	*11.2.3.3.3. b) Students are encouraged to research and* ***make presentations*** *on the use of the behaviour of charged particles in the electric field in technology.*
5. Organizing processes where students can have scientific discussions	6	*0.8*	*11.2.5.1. Students are encouraged to research the voltage values used in the electricity networks of different countries and* ***discuss the reasons*** *for using these values based on their research findings.*
6. Assigning tasks that enable students to work collaboratively	-	-	
TOTAL	88	*11.6*	

In Table 5, the most prominent indicator under the theme of 'Science Communication' was 'To be able to express knowledge in different ways' (f=68, 9%). Following this, it was noted that the indicators 'Ensure correct technical/scientific terminology (SI, IUPAC system, etc.)' (f=9, 1.2%), 'Organizing processes where students can have scientific discussions' (f=6, 0.8%), and 'Enabling students to make presentations using scientific language' (f=5, 0.7%) received emphasis. Additionally, the indicators 'Guiding students to access reliable sources of information by enabling them to distinguish between scientific knowledge and myths' and 'Assigning tasks that enable students to work collaboratively' were not associated in any of the statements. At this juncture, it can be concluded that the program lacks objectives that support students' information literacy or guide them toward group work.

Upon examination of the indicator 'To be able to express knowledge in different ways,' expressions related to the sub-indicators 'writing/understanding numerical expressions' (f=33, 4.4%), 'modelling/understanding' (f=18, 2.4%), 'creating/reading graphics' (f=16, 2.1%), and 'writing a scientific text/report' (f=1, 0.1%) were found. An example illustrating these relationships is found in "9.3.1.3. b) Students are enabled to derive and interpret mathematical models related to motion by using graphs." This objective notably emphasizes the indicator focused on enabling knowledge to be expressed in diverse manners, as evident in the explanation of the outcome.

There are three indicators under the 'Scientific Research' theme, and the results of the analysis are presented in Table 6.

Table 6
"Scientific Research" Theme Analysis Results and Statement Examples

E. SCIENTIFIC RESEARCH	f	%	*Example of a statement*
1. Enabling students to acquire scientific process skills a. Asking questions/questioning (f=0) b. Making predictions/Hypothesizing (f=0) c. Defining dependent, independent and control variables (f=18) d. Following the process steps (f=0) e. Data collection (scanning sources, making observations, making measurements) (f=12) f. Saving data (f=0) g. Analyzing data (classification, association, comparison, etc.) (f=51) h. Evaluating Data (making decisions, inferences, etc.) (f=31) i. Deepening/expanding (asking new questions, developing solutions, transferring the research result to real life, etc.) (f=4)	115	*15.2*	*9.3.1.2.* ***Relates*** *the concepts of position, distance travelled, displacement, velocity and speed.* *9.4.4.2.* ***Develop suggestions*** *to increase the efficiency of a sample system or design.* *9.5.5.1.* ***Interpret the effects*** *of expansion and contraction in solids and liquids in daily life.* *10.2.2.2.* ***Produce solutions*** *to problems in daily life related to buoyancy by using buoyancy and/or Bernoulli's Principle.* *10.3.3.2.* ***Analyzes the reflection*** *of linear and circular water waves.* *11.1.2.2.* ***Interprets the motion*** *of objects with constant speed in a moving environment according to different observation frames.* *11.1.4.4.* ***Analyzes the variables*** *related to the air resistance force acting on falling objects.* *11.2.4.11.* ***Makes inferences*** *about the causes of electromotive force.*
2. Guiding students to design, conduct and discuss a research/project	11	*1.5*	*11.1.10.3.* ***Designs*** *a safe system with simple machines to make life easier.*
3. Ensure the safe conduct of scientific work a. Work safety (f=0) b. Ethics (f=1)	1	*0.1*	*9.1.4.1. b) Complying with* ***ethical principles in scientific research*** *is emphasized.*
TOTAL	127	*16.7*	

According to Table 6, it was found that most statements were related to the indicator 'Enabling students to acquire scientific process skills' (f=115, 15.2%). Notably, 'Analyzing the data' (f=51, 6.7%) and 'Evaluating data' (f=31, 4.1%) indicators were frequently mentioned. In addition, it was also determined that there were no acquisitions pointing to some scientific process steps in the program. There were fewer associations with the indicator 'Guiding students to design, conduct, and discuss a research/project' (f=11, 1.5%). The indicator 'Ensure the safe conduct of scientific work' had minimal emphasis (f=1, 0.1%). For instance, in table "10.3.3.2," the statement "Analyzes the reflection of linear and circular water waves" is identified as an outcome statement that facilitates students' acquisition of the scientific process skills outlined in the E1 indicator. This assertion is grounded in the understanding that analysis constitutes a segment of the scientific process steps. In another example, the outcome statement highlighting the significance of adhering to ethical principles in scientific research also aligns with the promotion of safe scientific practices, as expressed in the E3 indicator.

Upon examination, it was observed that there was no emphasis in the 'Objectives and Explanations' section regarding the sixth and final theme, 'Measurement and Evaluation'. This is evident as there were no mentions or expressions within the objectives and explanations regarding monitoring evaluations, completion studies, feedback corrections, utilization of evaluation criteria, or testing students with real-life situations.

DISCUSSION, CONCLUSION and RECOMMENDATIONS

This study aimed to assess the extent to which the secondary school physics curriculum is associated with life. The findings reveal that 'Relating to Life' is frequently emphasized in the curriculum. This emphasis signifies the cultivation of scientifically literate individuals through programs that encourage a general connection to life. Consequently, the development of students' critical thinking skills is supported (Darling-Hammond et al., 2020; Wiwin et al., 2020; Pursitasari et al., 2019). In addition, the study revealed that associations with life were particularly frequent, especially under the theme of 'Basic Concepts and Principles.' Within this theme, the curriculum establishes connections with life by accurately sharing scientific facts and concepts related to subjects with students. It further involves preparing students for learning by capturing their attention, supporting the concretization of ideas with examples, and facilitating the transfer of learned concepts to new situations through activities such as question-solving, experiments, games, etc., employing various learning strategies. The inclusion of basic concepts and principles associated with life in the curriculum suggests that students are encouraged to address context-based questions. It is recognized that context-based questions allow for the easy analysis of physics knowledge in real-life problems, transforming students' abstract knowledge into concrete applications (Darling-Hammond et al., 2020; Sari et al., 2023). Besides, it is thought that it is desired to prevent the learning difficulties of students who integrate physics materials with daily life processes by discovering that physics is a part of life in the 21st century (Sarwi et al., 2019). In addition, when considering the secondary school physics curriculum in general terms, it was observed that the level of association with life was the least under the theme of 'Measurement and Evaluation.' It is believed that this situation stems from the curriculum's primary emphasis on objectives. This is because outcome statements under the portray the behaviors that students are intended to acquire (Jenkins & Unwin, 2001). Notably, only statements under the outcome serve as guiding directives crafted for educators to impart these behaviors to students (MEB, 2018). Currently, examples of objective explanations include activities such as providing feedback, project evaluation using rubrics, peer assessment, etc. However, it is proposed that formative assessments supporting teaching should be integrated (Black et al., 2004; Dixson & Worrell, 2016), and the utilization of measurement and evaluation indicators within the teaching process should be amplified. This enhancement aims to ensure that the theme of measurement and evaluation is not disregarded in aligning the curriculum with real-life applications. Additionally, it has been identified that real-life problems are inadequately integrated into the evaluation segment of the secondary school physics curriculum. This insufficiency may lead to decision-making based on intuition and opinions, potentially causing misconceptions among students due to the absence of opportunities for self-evaluation using real-life problems (Resbiantoro & Setiani, 2022). This situation also points out the deficiency in the secondary school physics course curriculum in terms of monitoring evaluations to identify students' learning gaps and the lack of planned completion studies to address these deficiencies. In other words, it is believed that students, due to deficiencies in the evaluation phase, may struggle to provide sufficient explanations when confronted with various daily life examples. This deficiency is seen as an inevitable outcome leading to misconceptions at specific points (Karataş, 2017; Potvin & Cyr, 2017).

In the section titled 'Ministry of National Education Curricula' and 'Implementation of the Secondary School Physics Curriculum,' referred to as the 'Introduction' of the secondary school physics curriculum, it was observed that the theme of 'The Role of Science' frequently emphasized connections with life. Here, a connection with life is established by utilizing different disciplines, mentioning the historical development of scientific studies, and including scientists. When making connections with life through the utilization of different disciplines, the aim is presumed to provide students with a two-way flow of information and foster a holistic understanding (Starkey et al., 2023). Besides, by incorporating scientists and the historical development of scientific studies into life connections, it is revealed that students are prompted to make sense of the scientific methods used in the process, rather than merely memorizing content (Costa & Broietti, 2021). As stated in the curriculum, it is evident that the association of

physics with life supports students' lasting learning (Kahraman Erdoğan & Karataş, 2023). Furthermore, in this section, the least emphasis on making connections with life was found in the 'Basic Concepts and Principles' theme. Here, only the inclusion of whether students have the knowledge and skills needed and are ready to learn with their previous learning is mentioned. Under the heading 'Structure of the Secondary School Physics Curriculum,' which includes the objectives and explanations of the 9th, 10th, 11th, and 12th-grade curricula, it was found that, contrary to the introduction section, the association with life was mostly mentioned under the theme of 'Basic Concepts and Principles.' Specifically, the correct explanation of scientific concepts was frequently mentioned under this theme. Therefore, it is believed that under this theme, students are provided with the opportunity to rationally solve new problems they encounter by having the right knowledge and to develop individuals who question, research, and transfer knowledge to technology. Because while daily events can be explained with experience and intuition, it is known that physics concepts cannot be directly inferred from daily events (Körhasan & Kaltakçı Gürel, 2019). For this reason, it was found that the curriculum also emphasizes question-solving and experimentation activities to transfer learned concepts and principles to new situations. In this way, it is believed that academic achievement will increase in the process, as Daşdemir and Okutan (2019) argue, since students will have a high chance to practically repeat the subjects by providing more opportunities to apply them. Moreover, under the theme of 'Effective Learning Environment,' it was determined that the association of the curriculum with life was mostly desired to be realized by using information and communication technologies and the use of laboratory equipment. At this point, it comes to mind that students studying in schools with a high socioeconomic status may have an advantageous position. Considering the results of PISA 2015 and TIMSS 2015, it is revealed that technology and laboratory facilities in schools are factors in raising students as science-literate individuals. Therefore, it is observed that the socioeconomic structure plays a role in raising science-literate individuals (OECD, 2018; Yıldırım & Ceylan, 2020). In line with the related statement, it is noted that students with internet access at home and who can use computers have higher levels of associating subjects with life (Karip, 2017). However, the absence of curriculum statements involving intervention in the physical conditions of the classroom, guiding students to utilize out-of-school learning environments, and supporting the utilization of scientific resources and daily life materials by students is considered a weakness within the effective learning theme. This omission is noteworthy because leveraging resources such as museums, science centers, etc., is believed to significantly contribute to students' academic success, their attitude toward the subject, their sustained learning, and their comprehension of the role of science in daily life (Harris, 2017; Martin et al., 2016). In essence, the synergy between students' engagement with materials and scientific resources and their exposure to out-of-school learning environments is deemed fundamental in establishing effective learning environments conducive to firsthand knowledge acquisition. In another result obtained in the study, it was determined that simple daily life connections under the theme of 'The Role of Science' were made by utilizing the knowledge of the mathematics discipline. Here, in the light of interdisciplinary knowledge, it is seen that how future learning and teaching are desired is revealed through contexts. In addition, with an interdisciplinary perspective, it is crucial to understand where the knowledge of each discipline comes from and how it should be blended into teaching through a contemporary understanding (Starkey et al., 2023). In the study, under the theme of 'Science Communication,' it was emphasized that the association of the secondary school physics curriculum with life was realized through numerical expressions by aiming to transfer knowledge differently. Under this theme, it was determined that association with life was achieved through modeling and creating/reading graphics. The purpose here is thought to be presenting complex data that cannot be shown in a text by visualizing their relationship with existing data and thus bringing together verbal and numerical information (Aydın & Tarakçı, 2018). Moreover, within this thematic scope, it was noted that the program lacked objectives fostering students' information literacy or collaborative group work. Nonetheless, in today's digital era where information access is readily available, it's crucial for individuals to possess strong information literacy skills enabling them to discern between credible and misleading information. Hence, there is a belief

that curricula should be revised to cultivate information-literate individuals, aligning with the demands of the modern age. Furthermore, it is advisable to integrate group work within enriched teaching environments employing scientific language. This inclusion can bolster the development of students' communication skills and enhance their comprehension of the scientific method (Malik & Ubaidillah, 2021; Mercer-Mapstone & Kuchel, 2017). The study determined that under the theme of 'Scientific Research,' associating with life was included in the curriculum to ensure the acquisition of scientific process skills. In this context, it has been noted that the curriculum includes some scientific process steps within the scientific process skills. Among these, the most significant step mentioned is the analysis of data (classification, association, comparison, etc.) and its correlation with real-life scenarios. Because it is known that to develop students' ability to analyze the events around them, they must first be able to associate physics with daily life (Haryanto et al., 2019). It is conceivable that students who achieve this can readily apply their knowledge in out-of-school learning environments. Consequently, the effectiveness of their ability to analyze data through extracurricular applications will enhance their attitudes and skills (Staman et al., 2014).

In light of these results, it is evident that the MoNE 2018 physics curriculum frequently incorporates associations with life. However, the research revealed that the curriculum, primarily designed for teachers, lacks effectiveness in measuring and evaluating life. These findings are expected to provide insights for future curriculum development and revision efforts, particularly in terms of enhancing connections with life. Considering that life events demand an interdisciplinary approach, it is essential to analyze curricula from other disciplines, such as biology, chemistry, mathematics, etc., to establish connections with life and conduct more comprehensive assessments through comparative studies. Furthermore, curricula only materialize in teaching environments when implemented by teachers. Therefore, it is crucial that the life connections emphasized in the curricula are effectively conveyed to teaching environments by practitioners. From this perspective, it is hoped that the findings from this study will contribute to the examination of curricula across different levels and disciplines concerning their connections with life. Additionally, it aims to enhance practitioners' ability to integrate life-related aspects into teaching environments.

Limitations of the Study

The findings derived from this study are confined to the 2018 MoNE Secondary School Physics Curriculum. The research aimed to acquire in-depth insights into the realm of physics by concentrating on this specific field. Moreover, in this study, the exploration of 'associating with life' was undertaken within the framework of 'Themes and Indicators regarding Associating Science Course with Life,' as formulated by Derman (2019).

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Statement of Contribution Rate

The authors of the study contributed equally to all processes of the research.

Declaration of Conflict of Interest

As the study's authors, we declare that we do not have any declaration of interest/conflict.

Statement of Publication Ethics

All the regulations outlined in the 'Higher Education Institutions Scientific Research and Publication Ethics Directive' were adhered to throughout the entire process, spanning from planning and implementation to data collection and analysis. None of the actions specified under the second section of the Directive, titled 'Scientific Research and Publication Ethics Actions,' have been executed.

Throughout the writing process of this study, scientific, ethical, and citation rules were meticulously observed; no falsification was undertaken on the collected data, and this study was not submitted to any other academic media for evaluation.

Research ethics committee approval information

As this study falls within the category of document analysis research, which does not require Ethics Committee Approval, it is not considered among the studies that necessitate Ethics Committee Approval. Therefore, no Ethics Committee Approval has been obtained for this study.

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GENİŞLETİLMİŞ ÖZ

Giriş

Fizik, insan yaşamının bir parçası olmakla beraber doğa ve yaşamın temelini oluşturmaktadır. Fizik bilgisi bireylerin soyut olayları somutlaştırılarak anlamlı öğrenmelerini destekleme rolünü üstlenmektedir (Uden vd., 2023). Fiziği yaşamımıza transfer ettiğimizde yaşam ile öğrenme arasında kurulan köprü ile anlamlı öğrenme gerçekleşirken öğrencilerin öğrendikleri ile okul dışında da uygulama yapma fırsatları doğmaktadır (Poquet vd., 2021). Bu koşulların fizik eğitimine yansımasının da ancak nitelikli bir öğretim programı aracılığıyla olacağı bilinmektedir (Akgün vd., 2015).

Öğretim programlarının ortak anlayışı içerisinde bireyleri gerçek dünyaya hazırlama amacı ön plana çıkmaktadır. Ülkemizde de Millî Eğitim Bakanlığı (MEB) tarafından hazırlanan Ortaöğretim Fizik Dersi öğretim programında bilgiyi üreten ve bunu hayatta işlevsel olarak kullanabilen bireylerin yetiştirilmesinin amaçlandığı ifade edilmektedir (MEB, 2018). Ancak birçok araştırma sonucunda öğrencilerin öğrendikleri kavramların günlük yaşamla ilişkisini tam olarak anlamlandıramadıkları ifade edilmektedir. Bu noktadan hareketle alanyazında ortaöğretim fizik dersi öğretim programının yaşamla ilişkilendirilme düzeyinin detaylı analizine ihtiyaç duyulduğu ortaya çıkmaktadır. Bu araştırmada ortaöğretim fizik dersi öğretim programının yaşamla ilişkilendirilme düzeyinin belirlenmesi ve böylece öğrencilerin bu ders kapsamında yaşama ne düzeyde hazırlanabileceğinin saptanması amaçlanmıştır.

Yöntem

Araştırmada nitel araştırma yöntemlerinden doküman analizi yönteminden yararlanılmıştır.

Araştırmanın veri kaynağını Türkiye'de 2018 yılında yayınlanan ortaöğretim fizik dersi öğretim programı oluşturmaktadır (MEB, 2018). Talim Terbiye Kurulu Başkanlığının resmî web sitesinden elektronik haline ulaşılan öğretim programı Derman (2019) tarafından hazırlanan "Fen Bilimleri Dersinin Yaşamla İlişkilendirilmesine İlişkin Tema ve Göstergeler" kullanılarak içerik analizi yöntemi ile bütüncül ve ayrıntılı şekilde çözümlenmiştir.

İçerik analizi sürecinde Ortaöğretim Fizik Dersi Öğretim Programı iki bölüm altında incelenmiştir. İlk bölüm öğretim programının genel yapısını anlatan "Millî Eğitim Bakanlığı Öğretim Programları" ve "Ortaöğretim Fizik Dersi Öğretim Programının Uygulanması" başlıklarının incelenmesinden oluşmaktadır. İkinci bölüm ise "Ortaöğretim Fizik Dersi Öğretim Programının Yapısı" altında verilen her bir sınıf düzeyi için sırayla yer alan ünite, konu, kazanım ve açıklamaların altındaki kazanımlar ve açıklamaların incelenmesini içermektedir.

Bulgular

2018 yılı Ortaöğretim Fizik Dersi Öğretim Programının incelenmesi sonucunda programı içerisinde toplamda 866 kez "Yaşamla İlişkilendirmeye" yönelik vurgu yapıldığı tespit edilmiştir. Bu kapsamda genel olarak yaşamla ilişkilendirmeye en çok "Temel Kavram ve İlkeler" (f=266, %30,7), en az ise "Ölçme ve Değerlendirme" (f=9, %1) temasında değinildiği gözlemlenmiştir. Programın "Giriş" ve "Kazanım ve Açıklamalar" kısmı ayrı ayrı değerlendirildiğinde ise; "Giriş" bölümünde (birinci bölüm) en çok "Fen Bilimlerinin Rolü" temasına (f=49, %45,8) ilişkin ifadelere rastlanılmış, "Kazanım ve Açıklamalar" bölümünde (ikinci bölüm) de en çok "Temel Kavram ve İlkeler" teması ile (f=260, %34,3) ilişkilendirme yapıldığı görülmüştür. Programın giriş kısmında en az "Temel Kavram ve İlkeler" temasına (f=6, %5,6) ilişkin ifadelere yer verilmiş, "Kazanım ve açıklamalar" bölümünde "Ölçme ve Değerlendirme" temasına ilişkin herhangi bir ilişkilendirmeye yer verilmediği sonucuna ulaşılmıştır.

Tartışma, Sonuç ve Öneriler

Araştırma sonucunda ortaöğretim fizik dersi öğretim programı içerisinde "Yaşamla İlişkilendirmeye" sıklıkla vurgu yapıldığına rastlanılmıştır. Bu sonuç program aracılığıyla fen

okuryazarı bireylerin yetiştirilmesinin ve dolayısıyla öğrencilerin eleştirel düşünme becerilerinin gelişiminin desteklendiğini ortaya çıkarmıştır (Darling-Hammond vd., 2020; E Wiwin vd., 2020; Pursitasari vd., 2019).

Öğretim programında genel olarak en çok "Temel Kavram ve İlkeler" temasına ilişkilendirme yapıldığı görülmektedir. Bu sonuç öğrencilerin bağlam temelli sorular çözmelerinin istendiğini akla getirmektedir. Çünkü bağlam temelli sorular ile yaşam problemlerinin içerisinde yer alan fizik bilgisinin kolaylıkla analiz edilebildiği ve öğrencilerin soyut bilgilerinin somutlaşabildiği bilinmektedir (Darling-Hammond vd., 2020; Sari vd., 2023). Böylece 21. yüzyılda fiziğin yaşamın bir parçası olduğunu keşfederek fizik materyallerini günlük yaşam süreçleri ile bütünleştiren öğrencilerin öğrenme güçlüklerinin önüne geçilmesinin istendiği düşünülmektedir (Sarwi vd., 2019).

Yaşamla ilişkilendirilme düzeyinin en az "Ölçme ve Değerlendirme" temasında olması değerlendirme kısmında gerçek yaşam problemlerine yeterince yer verilmediğini ortaya koymaktadır. Öğrencilerin kendilerini yaşam temelli problemler ile değerlendirmelerine fırsat verilmediği noktada, sezgi ve kanılarla ulaşılan kararların yanılgı oluşturabileceği bilinmektedir (Resbiantoro & Setiani, 2022). Bu durum öğrencilerin farklı günlük yaşam örnekleri karşısında yeterli açıklamalar yapamayacaklarına ve belirli noktalarda kavram yanılgısına düşmelerinin kaçılmaz olacağına işaret etmektedir (Karataş 2017; Potvin & Cyr, 2017).

Programın "Giriş" kısmında "Fen Bilimlerinin Rolü" temasında yaşamla ilişkilendirmeye sıklıkla vurgu yapıldığı ve bu bağlamda farklı disiplinlerden yararlanılmasının, bilimsel çalışmaların tarihsel gelişimine değinilmesinin ve bilim insanlarına yer vermesinin vurgulandığı görülmektedir. Böylece bütüncül bir anlayış ile öğrencilere çok yönlü bir bilgi akışı sağlanmasının istenildiği düşünülmektedir (Starkey vd., 2023).

Programın kazanımlar ve açıklamalarının sunulduğu ikinci kısmında "Etkili Öğrenme Ortamı" temasında en fazla bilgi ve iletişim teknolojilerinden yararlanarak ve laboratuvar araç-gereçlerinin kullanımına vurgu yapıldığı saptanmıştır. Bu noktada sosyoekonomik düzeyi yüksek olan okullarda öğrenim gören öğrencilerin avantajlı konuma sahip olabilecekleri akla gelmektedir. Çünkü PISA 2015 ve TIMSS 2015 sonuçları göz önüne alındığında, öğrencilerin fen okuryazarı bireyler olarak yetiştirilmelerinde okullardaki teknoloji ve laboratuvar imkânlarının etken olduğu belirtilmektedir (OECD, 2018; Yıldırım & Ceylan, 2020). "Fen Bilimlerinin Rolü" temasında basit günlük yaşam bağlantılarının matematik disiplininin bilgisinden yararlanılarak gerçekleştirildiği tespit edilmiştir. Burada disiplinlerarası bakış açısıyla her bir disipline ait bilginin nereden geldiği ile bu bilginin çağdaş anlayış aracılığıyla öğretime harmanlanarak yansıtılmasının nasıl gerçekleştirilmesi gerektiğinin fark edilmesi ön plana çıkmaktadır (Starkey vd., 2023). "Bilim İletişimi" temasında ise, bilginin farklı şekilde aktarımında özellikle sayısal ifadelere dönüştürmeden faydalanıldığı ortaya çıkmaktadır. Araştırmada "Bilimsel Araştırma" temasında en fazla verileri analiz etme basamağı dikkat çekmektedir. Öğrencilerin çevrelerinde gerçekleşen olayları analiz etme yeteneklerinin geliştirilebilmesi için öncelikle günlük yaşamla fiziğin ilişkilendirebilmeleri gerektiği bilinmektedir (Haryanto vd., 2019). Bunu sağlayan öğrencilerin bilgilerini okul dışı öğrenme ortamlarında da kolaylıkla kullanabilecekleri ve dolayısıyla sınıf dışı uygulamalar aracılığıyla verileri analiz etme yetilerinin işlevselliği ile tutum ve becerilerinin gelişeceği düşünülmektedir (Staman vd., 2014).

Bu araştırmada elde edilen bulgular ortaöğretim fizik dersi öğretim programı ile sınırlandırılmıştır. Araştırmada fizik alanına yönelerek bu alanla ilgili derinlemesine bilgiye ulaşılması hedeflenmiştir. İlerleyen çalışmalarda fen bilimleri bağlamında kimya ve biyoloji alanları da ele alınarak disiplinlerarası karşılaştırmalı sonuçlara ulaşılması önerilebilir.